CLAIMS

1. An electrochemical flow monitoring device, comprising

a microfluidic system comprising at least one covered microchannel having an inlet and an outlet;

means for applying a pressure difference between the inlet and the outlet of said microfluidic system such as to generate a flow of solution within said covered microchannel;

wherein the microfluidic system has at least one electrode for monitoring said flow of solution by measuring an electrochemical property of said solution.

2. The device of claim 1, wherein said solution comprises a reporter molecule for monitoring said flow of solution by measuring said electrochemical property of said solution.

3. The device of claim 1 or 2, wherein said pressure difference is induced by gravity, namely by a difference in solution height between the inlet and the outlet of said covered microchannel.

4. The device of claim 3, wherein said microfluidic system is placed on or in a solid support which can be tilted in order to generate said difference in solution height between the inlet and the outlet of said covered microchannel.

5. The device of claim 1 or 2, wherein said means for applying a pressure difference comprises an external actuator.

6. The device of claim 5, wherein said external actuator comprises means for imposing a pressure on the fluid present at the inlet and/or within said

microchannel, thereby generating a solution flow within said microfluidic system.

7. The device of claim 5, wherein said external actuator comprises means for imposing an underpressure at the outlet of said microchannel, thereby enabling aspiration of said solution within said microchannel.

8. The device of any preceding claim, wherein said electrochemical property is a specific conductivity.

9. The device of any preceding claim, wherein said electrochemical property is a redox property.

10. The device of claim 9, wherein said redox property comprises the ability of a molecule e.g. ferrocene, ferrocene carboxylic acid, hexacyanoferrate or oxygen, dissolved in said solution to be reduced or, respectively, oxidized.

11. The device of any preceding claim, wherein said microfluidic system comprises a material selected from polymer, glass, ceramic, another flow tied material and a combination thereof.

12. The device of any preceding claim, wherein said microfluidic system comprises a multi-layer body.

13. The device of any preceding claim, wherein said microfluidic system comprises a light-transparent material.

14. The device of any preceding claim, wherein said microfluidic system is fabricated by a process selected from plasma etching, laser photoablation,

embossing, injection molding, UV-liga, polymer casting, silicon etching and any combination thereof.

15. The device of any preceding claim, wherein said at least one electrode is integrated in a wall portion of said microchannel.

16. The device of any one of claims 1 to 14, wherein said at least one electrode is not in direct contact with said solution in said microchannel.

17. The device of any preceding claim, wherein said integrated electrode has a precise size and location in said microfluidic system.

18. The device of any preceding claim, wherein said microfluidic system comprises a network of microchannels.

19. The device of any preceding claim wherein said microchannel is covered by one of a lamination, a sealing plate and a plate fixed over said microchannel and maintained by external pressure.

20. The device of any preceding claim, wherein said at least one electrode is composed of a conductive surface selected from a metal surface, carbon and a liquid/liquid interface.

21. The device of any preceding claim, wherein said at least one electrode serves to electrochemically detect an analyte in said solution in addition to the monitoring of said solution flow.

22. The device of any preceding claim, wherein said covered microchannel contains a biological compound.

23. The device of claim 22, wherein said biological compound is selected from an enzyme, an antibody, an antigen, an oligonucleotide, DNA, a DNA strain or a cell.

24. The device of claim 22 or 23, wherein said biological compound is immobilized in said covered microchannel.

25. The device of any preceding claim, wherein the application of said pressure difference can be stopped.

26. The device of claim 25, wherein the stopping of the application of said pressure difference is performed by mechanically blocking one of said inlet and said outlet of said microchannel.

27. The device of claim 25, wherein the stopping of the application of said pressure difference is performed by adding a liquid immiscible with said solution to at least one of said inlet and said outlet.

28. The device of claim 25, wherein the stopping of the application of said pressure difference is performed by electrochemical generation of a bubble in said microchannel.

29. The device of any preceding claim, wherein said flow of solution is used in an affinity sorbent assay in order to perform incubation of a solution in said microchannel and/or washing of said microchannel.

30. A method of performing an analytical assay comprising the steps of:

(a) providing a flow monitoring device according to any preceding claim;

(b) depositing a solution at the inlet of said covered microchannel;

(c) applying a pressure difference between the inlet and outlet of said microchannel in order to generate a flow of said solution in said microchannel; and

(d) measuring an electrochemical property of said flowing solution, which property depends on the flow rate of said solution in said microchannel, by means of said at least one electrode of said microfluidic system.

31. The method of claim 30, wherein steps b) to d) are repeated in order to perform a multistep assay.

32. The method of claim 30 or 31, wherein said pressure difference is generated by imposing an acceleration to the microfluidic system.

33. The method of claim 32, wherein said acceleration is induced by the displacement of said microfluidic system or of a solid support on or in which said microfluidic system is placed.

34. The method of claim 33, wherein said displacement consists either in rotating or in vertically lifting said microfluidic system or its solid support, so as to generate a gravitation force or, respectively, a centrifugal force.

35. The method of any one of claims 30 to 43, comprising stopping the application of said pressure difference in order to detect an analyte present in said solution.

36. The method of claim 35, wherein the step of stopping the application of pressure difference comprises mechanically blocking one of said inlet and said outlet of said microchannel.

37. The method of claim 35, wherein the step of stopping the application of pressure difference comprises adding a liquid immiscible with said solution to at least one of said inlet and said outlet.

38. The method of claim 35, wherein the step of stopping the application of pressure difference comprises electrochemically generating a bubble in said microchannel.

39. The method of any one of claims 30 to 38, wherein an analyte detected in the assay is directly used to monitor said solution flow by measuring an electrochemical property of said solution comprising said analyte.

40. The method of any one of claims 30 to 38, wherein an analyte is detected electrochemically by said at least one electrode.

41. The method of any one of claims 32 to 38, wherein at least a portion of said microfluidic system comprises a light-transparent material and an analyte is detected optically.